Evaluating New Technology Adoption for Fruit and Vegetable Growers: Does It Pay?

Wendong Zhang

Assistant Professor, Dyson School of Applied Economics and Management, Cornell University;

wendongz@cornell.edu

(607) 254-3231

https://wendongzhang.weebly.com/

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Eastern New York CHP Fruit and Vegetable Conference

Dyson
Cornell
SC Johnson College of Business

Research & Extension Program Themes

- **Theme I: Agriculture & the Environment; Grower Decision Making**
- **Theme II: Land Value, Land Ownership, Land Tenure, Land Use**
- **Theme III: Chinese Agriculture & its Global Trade Implications**
- Other Useful information:

  Appointment: 50% Research & 50% Extension

  Joined Cornell Dyson School & Cornell Cooperative Extension in July 2022

  Faculty Affiliate, Cornell Institute for China Economic Research (CICER)

  Faculty Fellow, Cornell Atkinson Center for a Sustainable Future

  Led Iowa land value survey; co-founded the ISU China Ag Center

  New Projects in New York State

  - Ag & Solar; Agrivoltaics (joint with David Kay and Rich Stedman)
  - Floodplain paddy rice farming (joint with Jenny Kao-Kniffin and Susan McCouch)
  - Carbon credits for dairy farmers (joint with Chris Wolf)
  - US Northeast Land Value & Rent Trends (joint with ASFMRA Northeast Chapter)

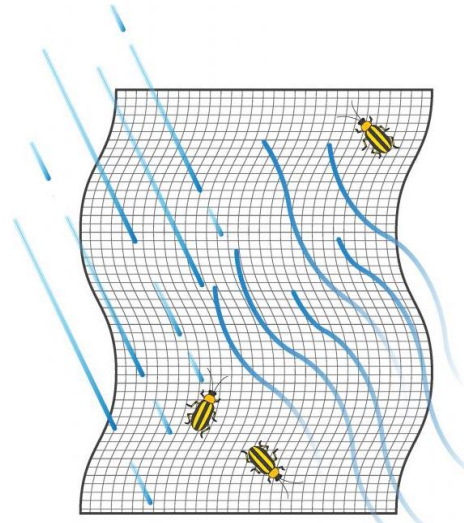
Story #1: Mesotunnels for Organic Cucurbit Production in New York, Kentucky and Ohio

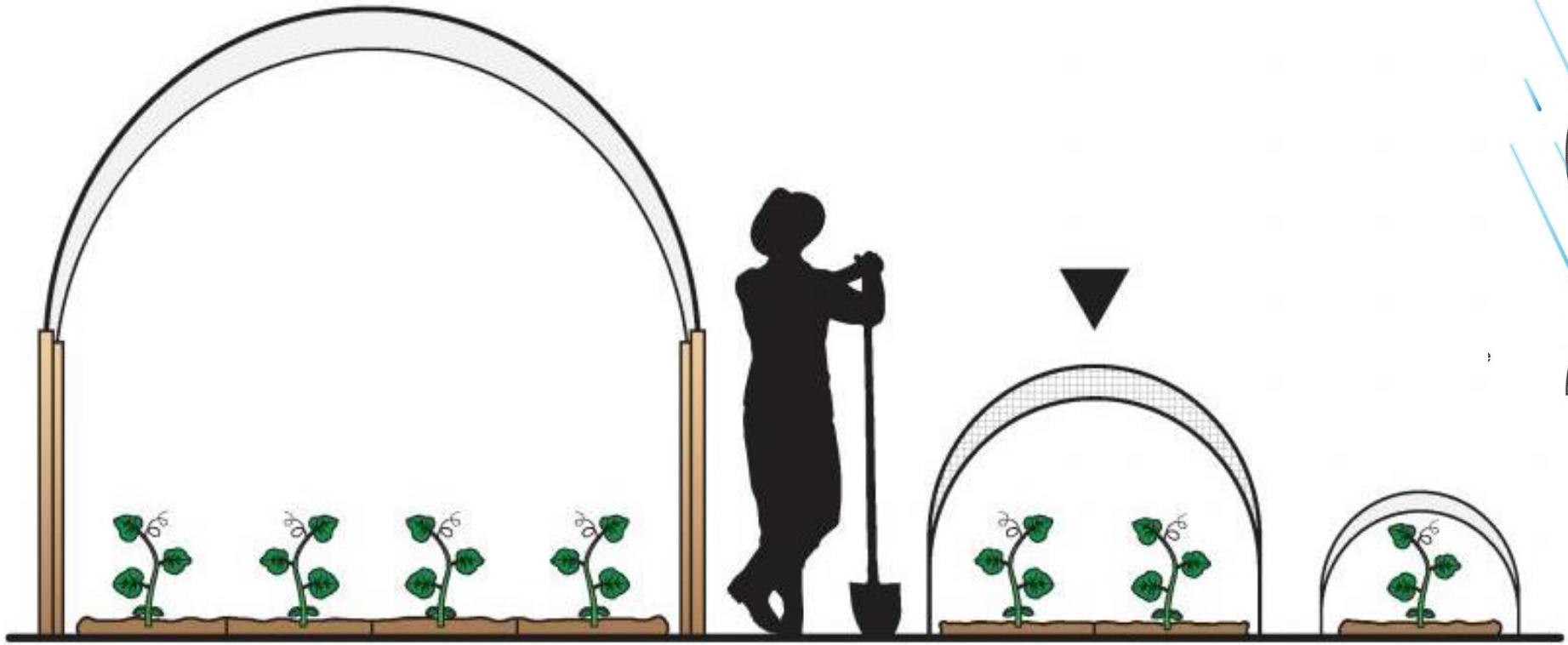
https://linktr.ee/currentcucurbit USDA NIFA OREI Project

Collaborators: Sarah Pethybridge (Cornell AgriTech), David Gonthier (U Kentucky), Mark Gleason (Iowa St)

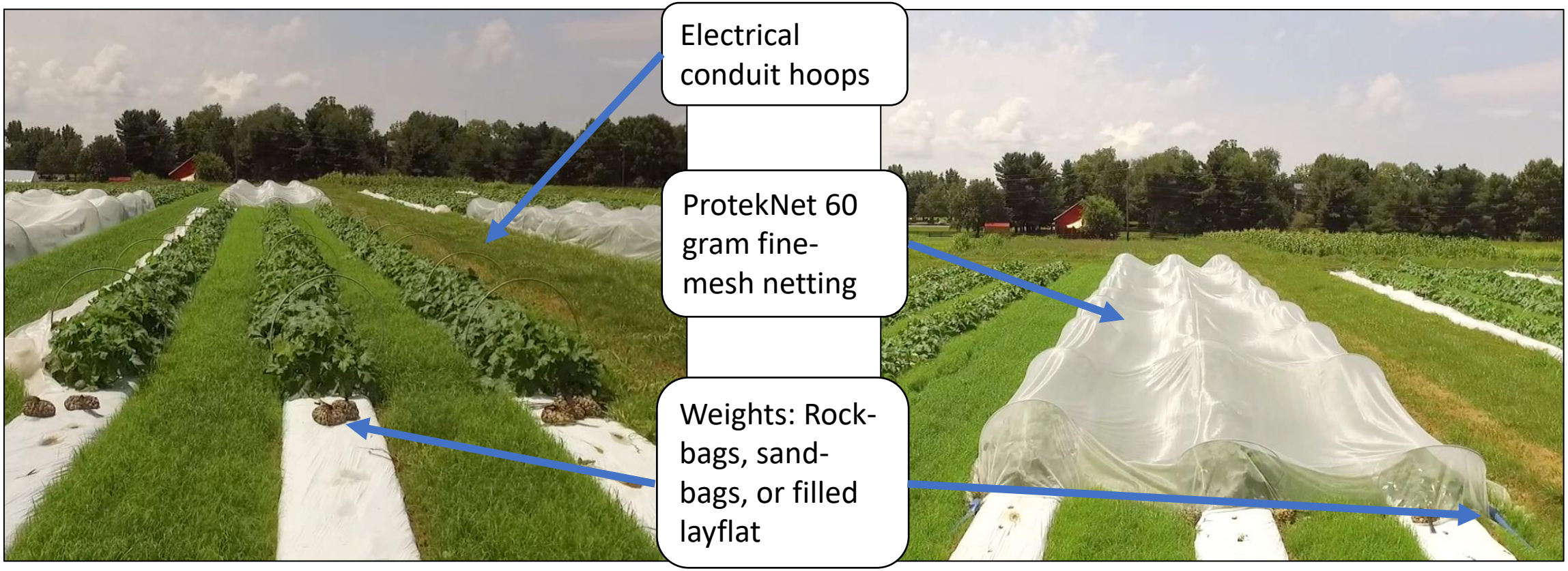
WHAT ARE MESOTUNNELS?

Nylon fine-mesh covers

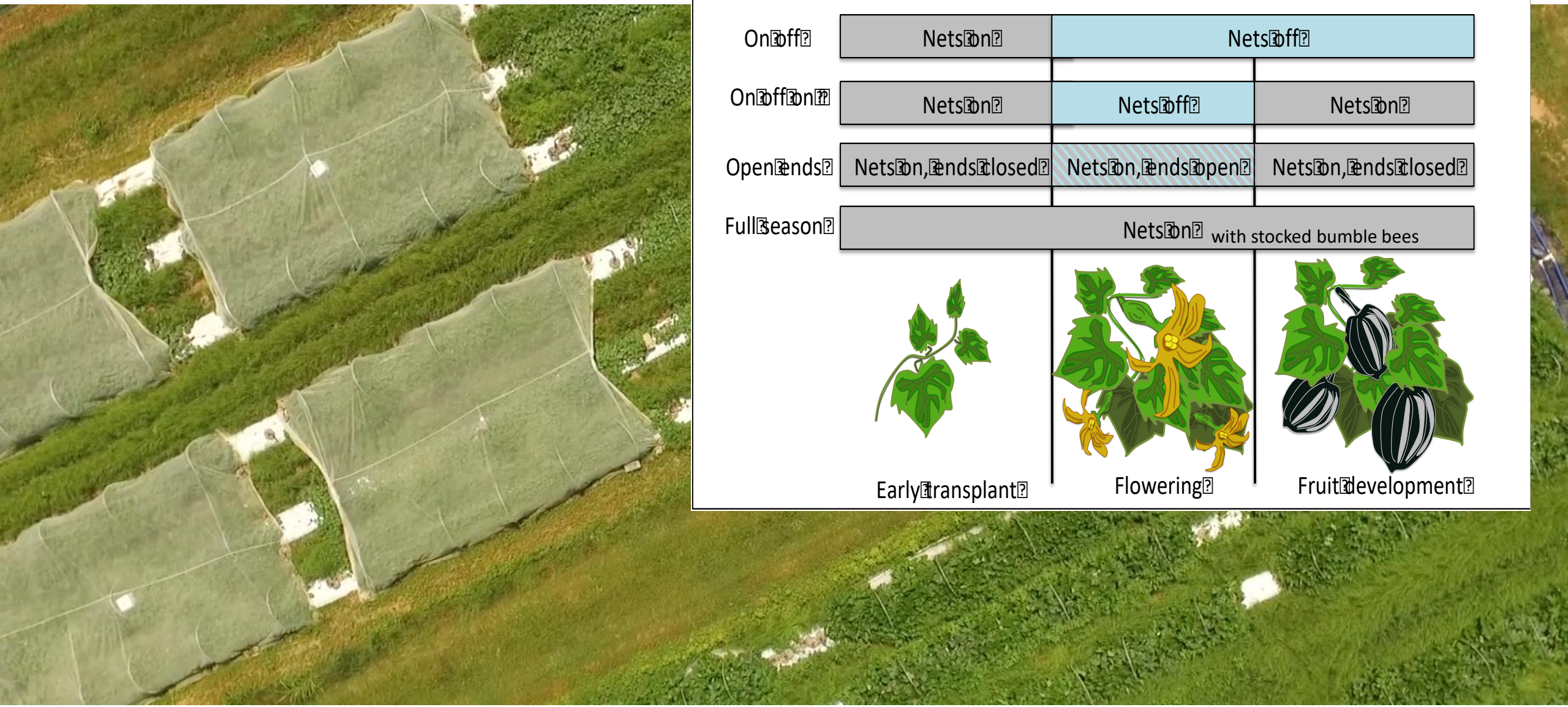




Mesotunnel protection system



Kentucky Pollination treatments during flowering

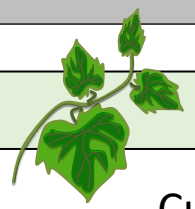


On-off-on strategy



On-off-on

Nets on	Nets off	Nets on
Early development	Flowering	Fruit development

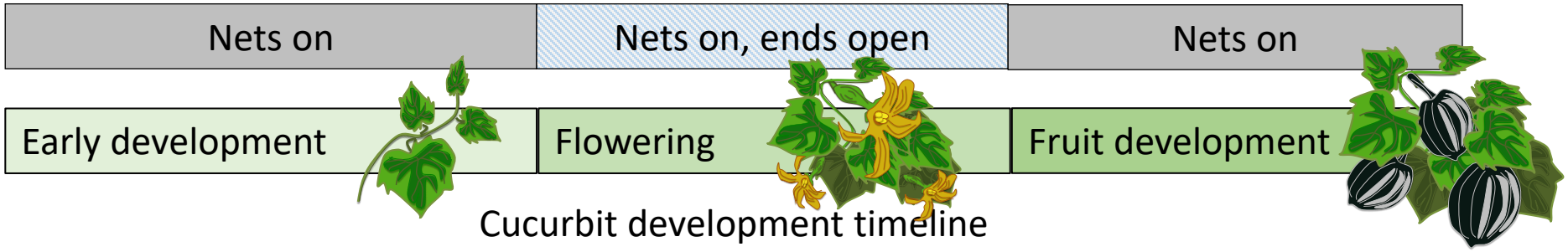


Cucurbit development timeline

Open-ends strategy



On-off-on



Cucurbit development timeline

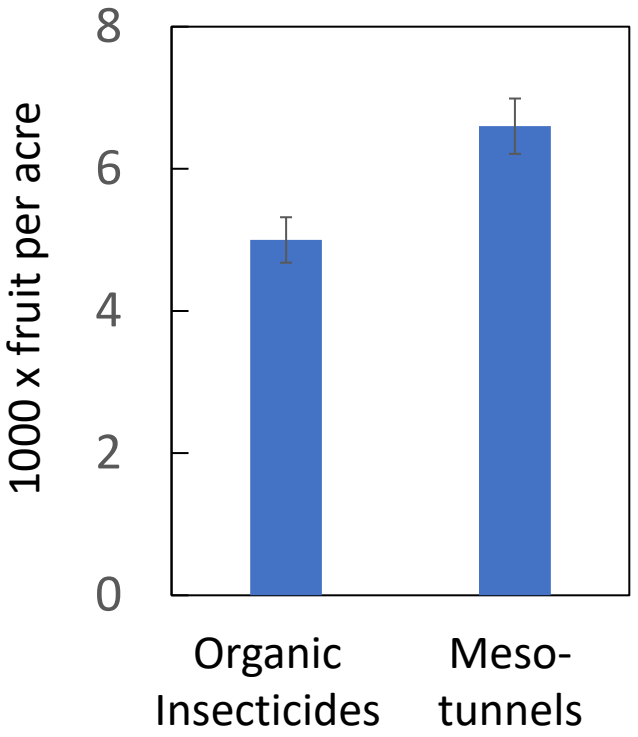
Full-season, with commercial bumble bees

Full-season

Nets on	Nets on	Nets on
Early development	Flowering	Fruit development

Cucurbit development timeline

Mesotunnels increase marketable yield by 30% in University of Kentucky trials



Fiske, Bessin, Williams, Gonthier. In prep.

Costs of mesotunnel vs organic pesticide management Kentucky – acorn squash

	Items	Control	Only Spray	Only Mesotunnel	Mesotunnel + Spray
Materials ($)	Mesotunnel	$ -	$ -	$ 3,153	$ 3,153
	Insecticide spray	$ -	$ 2,661	$ -	$ 2,605
	Other	$ 144	$ 144	$ 144	$ 144
Labor (min)	Mesotunnel	0	0	7173	7173
	Insecticide spray	0	4658	0	3105
	Other	1672	1672	1672	1672
Total Material Cost ($)		$ 144	$ 2,805	$ 3,296	$ 5,902
Total Labor Cost ($)		$ 324	$ 1,556	$ 1,815	$ 2,746
Total Cost ($)		$ 326	$ 4,361	$ 5,111	$ 8,648

*Preliminary results, not all field prep costs included, some costs are annualized

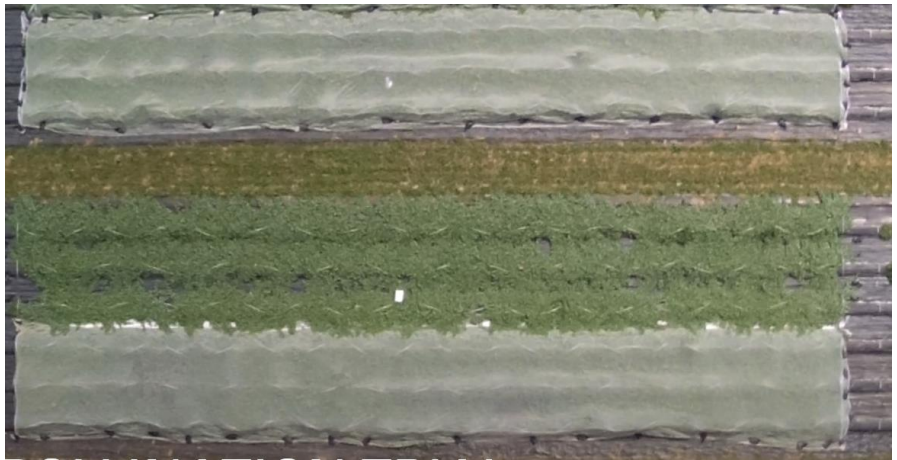
Mesotunnel profitability – acorn squash

1-Acre	Control	Spray only	Meso-tunnel	Meso-tunnel +spray
Selling Price ($/lb)	$ 1.77	$ 1.77	$ 1.77	$ 1.77
Total Cost ($)	$ 326	$ 4,361	$ 5,111	$ 8,648
Revenue ($)	$ 18,234	$ 15,926	$ 25,073	$ 24,744
Profit ($)	$ 17,908	$ 11,565	$ 19,962	$ 16,096

NY AgriTech Pollination Trials
2022 Muskmelon Yield Results

Marketable Fruit	On/Off/On	Open Ends	Full Season Mesotunnel with Bumblebee Hive
Number of marketable fruit (both harvests)	167.8	20.0	19.8
Total marketable fruit weight (both harvests; lb.)	862	115	117

Kellie Damann and Sarah Pethybridge

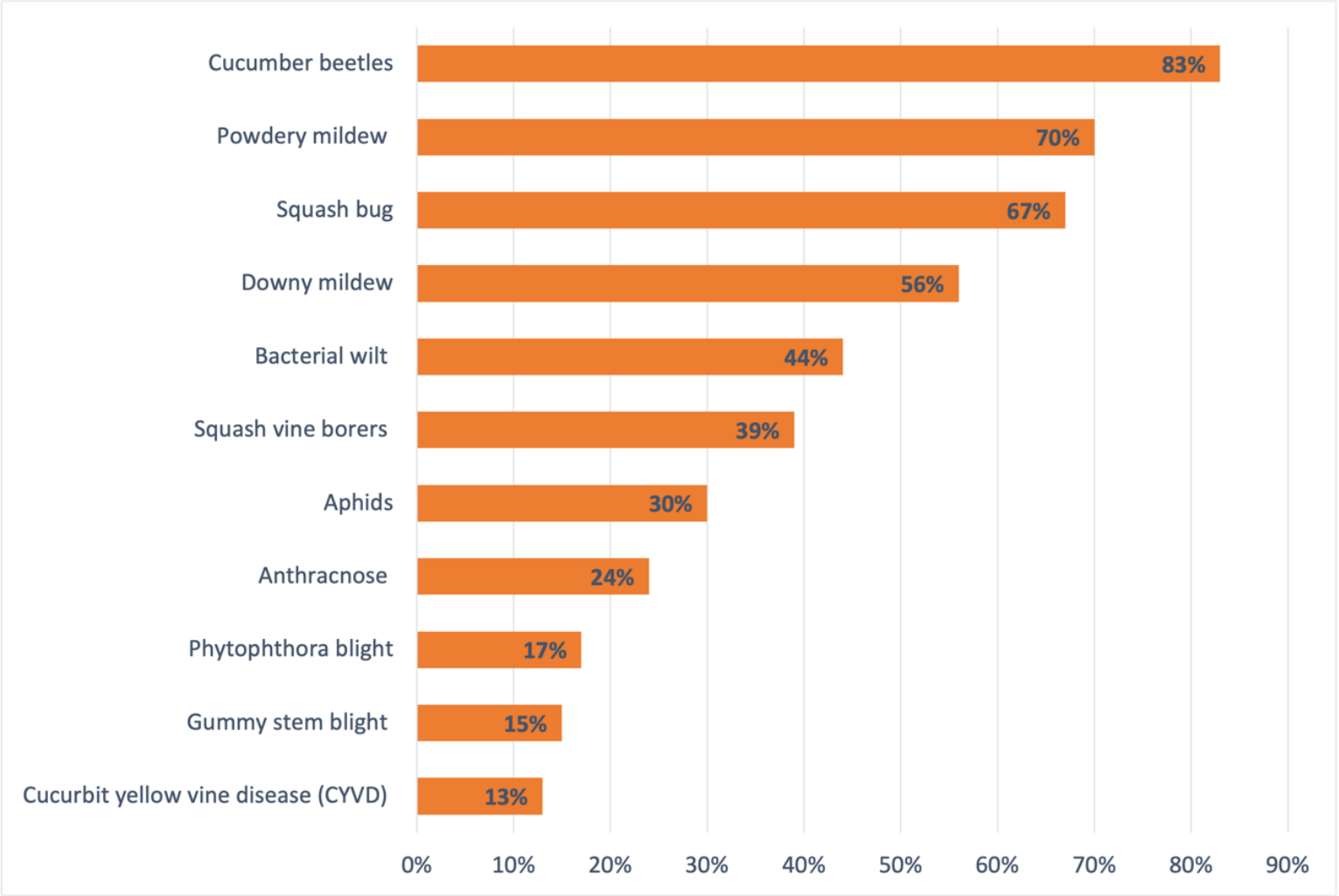


New York AgriTech Pollination Trials

Just having bumblebee hive is not enough – needs other pollinators

Variables	On/Off/On	Open Ends	Bumblebee Hive	LSD	P =
Week 4					
Bumblebees	2.3 a	0 b	3.5 a	2.4	0.031
Hoverflies	4.3	0.3	1.8	-	0.136 (ns)
Other bees	4.5 a	0.3 b	0.3 b	3.4	0.032
Other pollinators	3.5 a	0 b	0 b	2.4	0.017
Pollinators on the flowers	6 a	0 b	2 b	3.5	0.014
Flower number	535 a	448 ab	335 b	123.4	0.021
Week 5					
Bumblebees	6.2	1.3	7.5	-	0.375 (ns)
Hoverflies	29 a	4.3 b	3 b	7.1	<0.001
Other bees	43.2 a	6.8 b	0.5 b	16.3	0.001
Other pollinators	21.8 a	3.8 b	0.3 b	8.7	0.002
Pollinators on the flowers	43.8 a	6.2 b	5.5 b	17.9	0.003
Flower number	876	734	730	-	0.093 (ns)

2021 Organic Cucurbit Grower Survey



Data shows that 186 (88%), 20 (14%) and 142 (70%) used low-tunnel, mesotunnels and high tunnel, respectively.

Led by Nieyan Cheng, Wendong Zhang

the specific threats to the crops and farm production

Attitudes towards mesotunnel's Ease of Use and

	Agree(%)	Strongly agree(%)
Learning to use mesotunnels would be easy for me.	**51**	**18**
Mesotunnels would be easy to adapt to my vegetable farming system.	**36**	**15**
It would be easy for me to become skillful at using mesotunnels.	**38**	**17**

Usefulness or Efficacy of Mesotunnels

	Effective (%)	Very Effective (%)	Not sure (%)
Maximizing marketable yield	50.16	20.38	8.78
Reducing pesticide use	42.55	27.64	8.39
Controlling insect pests	45.07	34.33	4.48
Controlling diseases	31.23	15.28	11.96
Protecting crops from extreme weather events (such as cold, high wind, and hail)	38.39	21.36	9.60
Maximizing profitability	31.97	13.95	17.35

Over next 3 years, I am interested to apply mesotunnels to these crops

	Yes (%)	No (%)	# farmers
Cucumber	80	20	105
Acorn squash	28	72	82
Pumpkin	16.5	83.5	73
Muskmelon	34	66	85
Summer squash	56	44	86
Watermelon	52	48	112
Others	34	66	83

Story #2: Intelligent Sprayers for Apple Orchards in Ohio and Iowa

https://www.smartapplespray.plantpath.iastate.edu/

USDA NIFA – CPPM Project

Collaborators: Heping Zhu (USDA-ARS), Melanie Ivey (Ohio St), Mark Gleason (Iowa St)

Airblast sprayer – the standard since 1950s

Positives:

- Effective against pests and diseases.
- Technology is familiar.

Negatives:

- Prone to spray drift.
- Much of the spray misses target.

Laser-guided intelligent sprayer technology

An advanced and affordable spray system that avoids the orchard sprayer calibration and minimizes human involvements in spray volume decisions

Inventor: Dr. Heping Zhu, USDA ARS, Wooster, OH

Commercially available at Smart Apply, Inc. in Indianapolis, IN

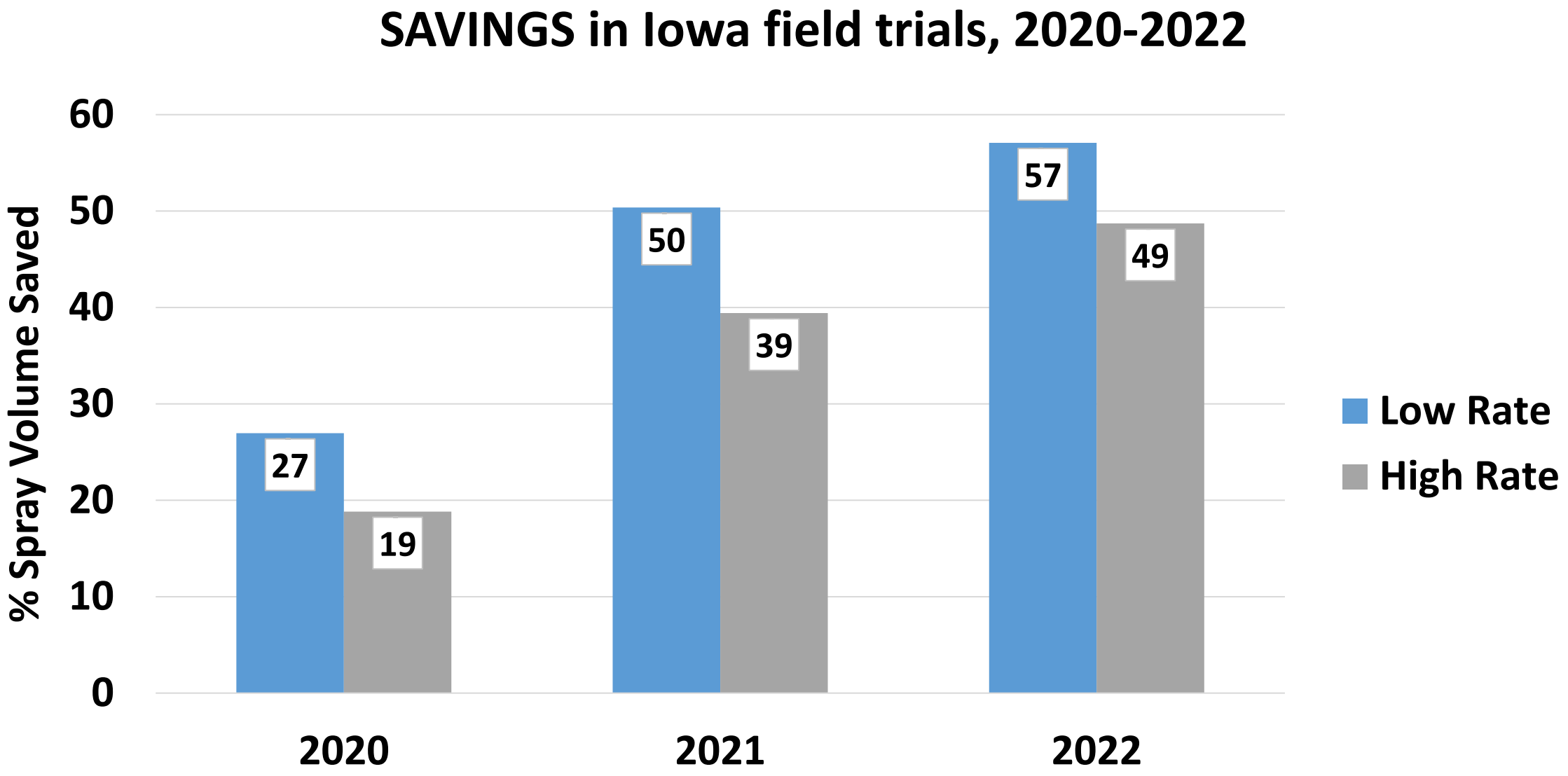
Intelligent Sprayer in Action

https://www.smartapplespray.plantpath.iastate.edu/

Video credit: Heping Zhu, Wooster, OH

USDA United States Department of Agriculture
Agricultural Research Service

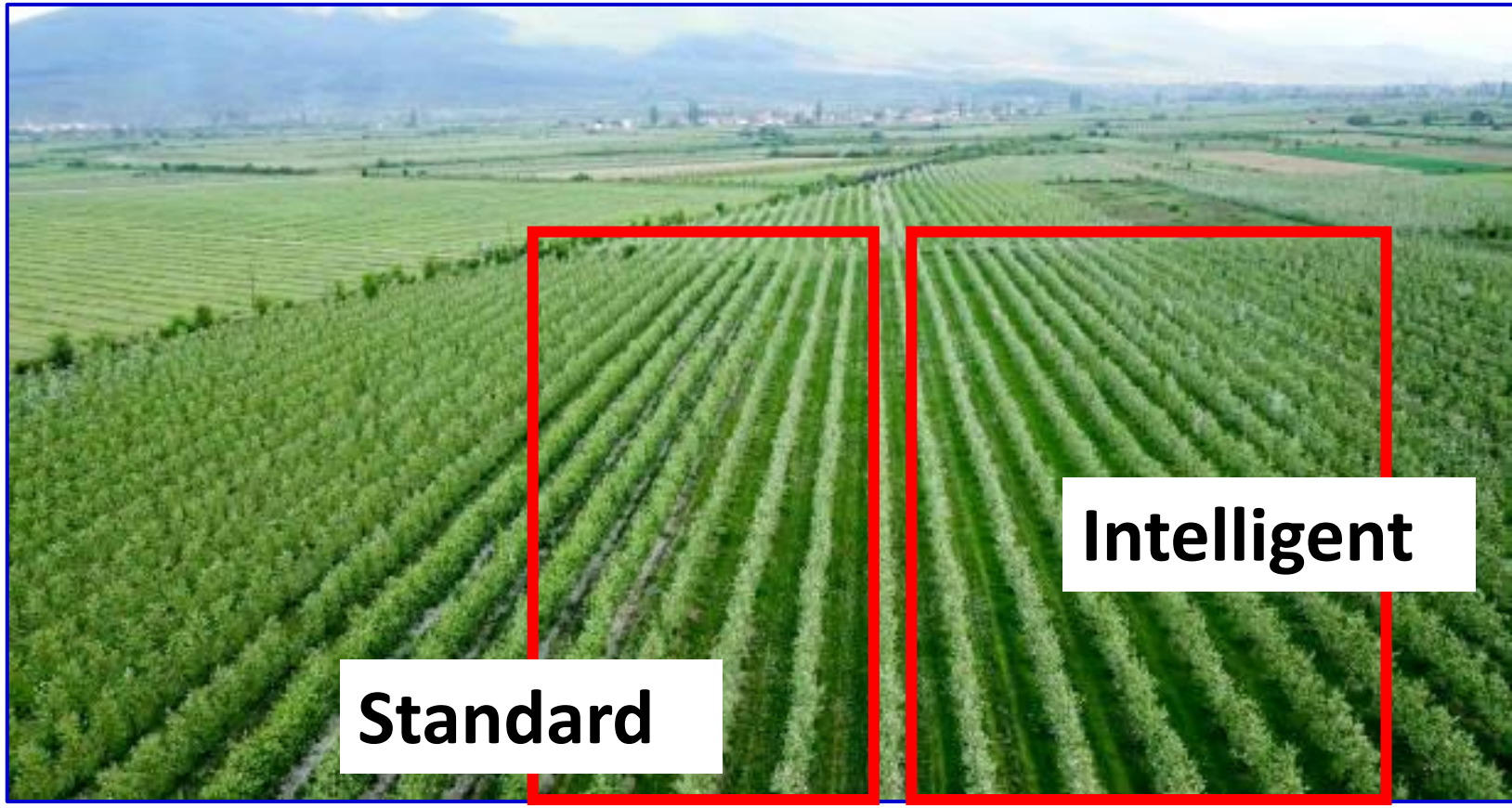
Smart Apple Spraying



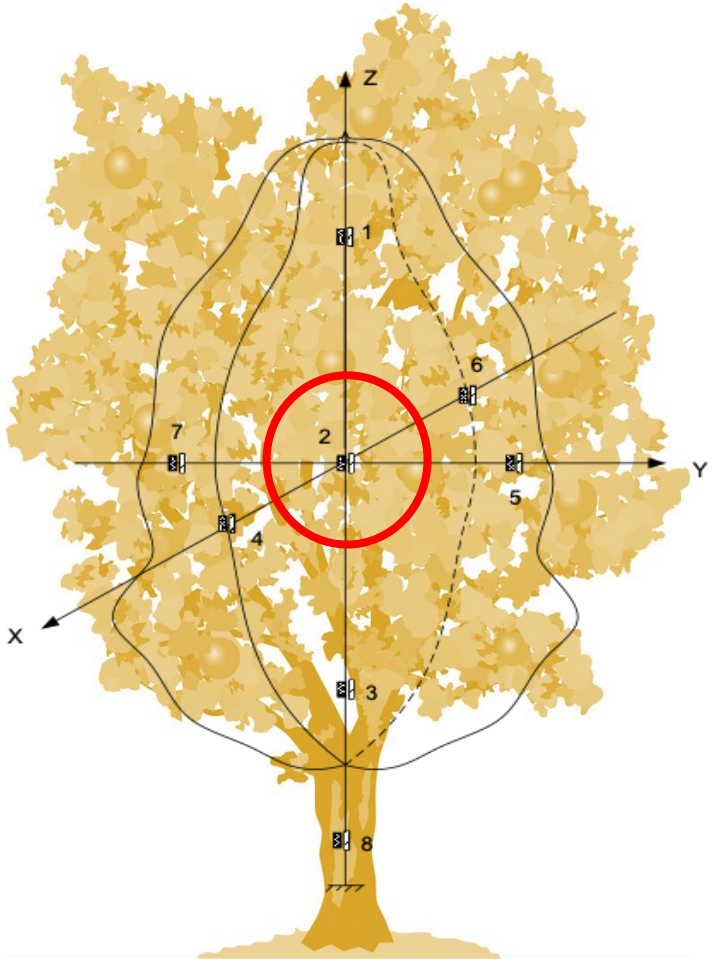
Intelligent Sprayer saved 30-60% per spray *vs.* airblast.

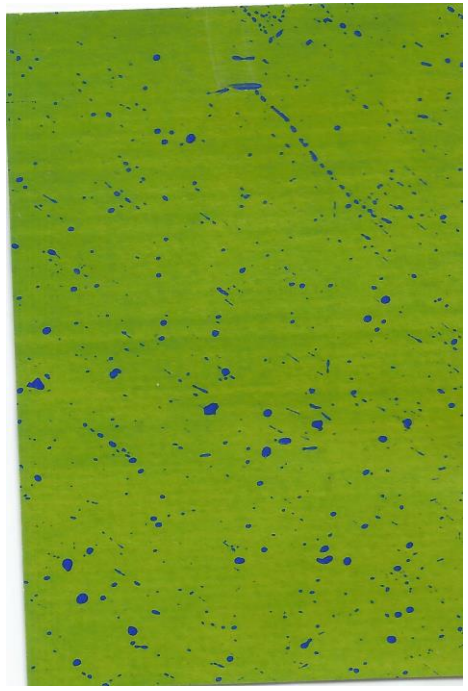
Intelligent Sprayer save refilling trips

- Cover 30-50% more orchard with the same spray volume.
- Less drift
- Less labor costs



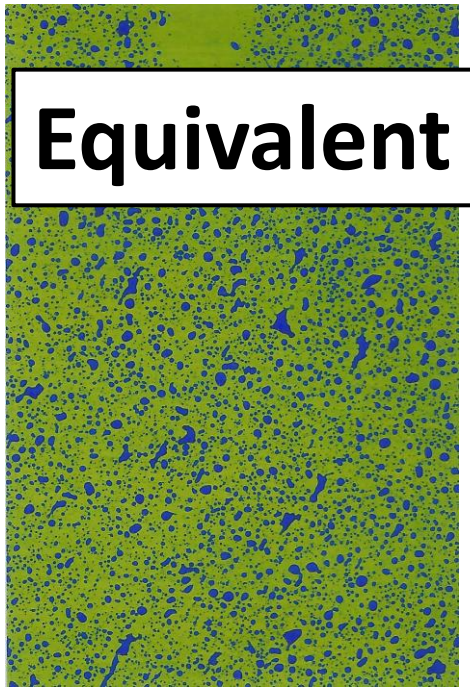
Spray Coverage (2021)



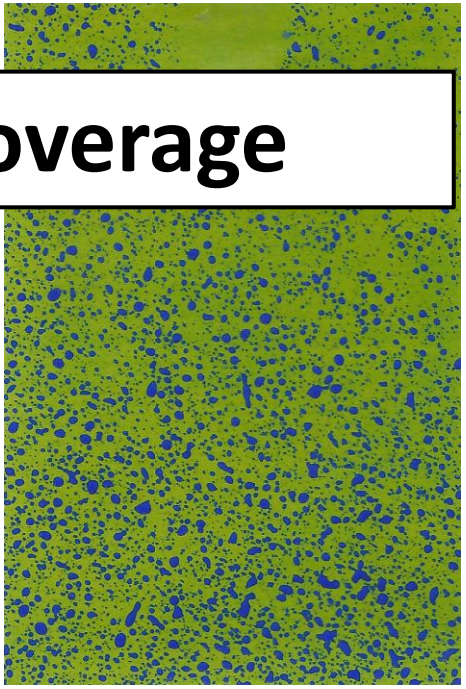


Intelligent
(0.06 fl oz/ft3)
3%

Equivalent coverage

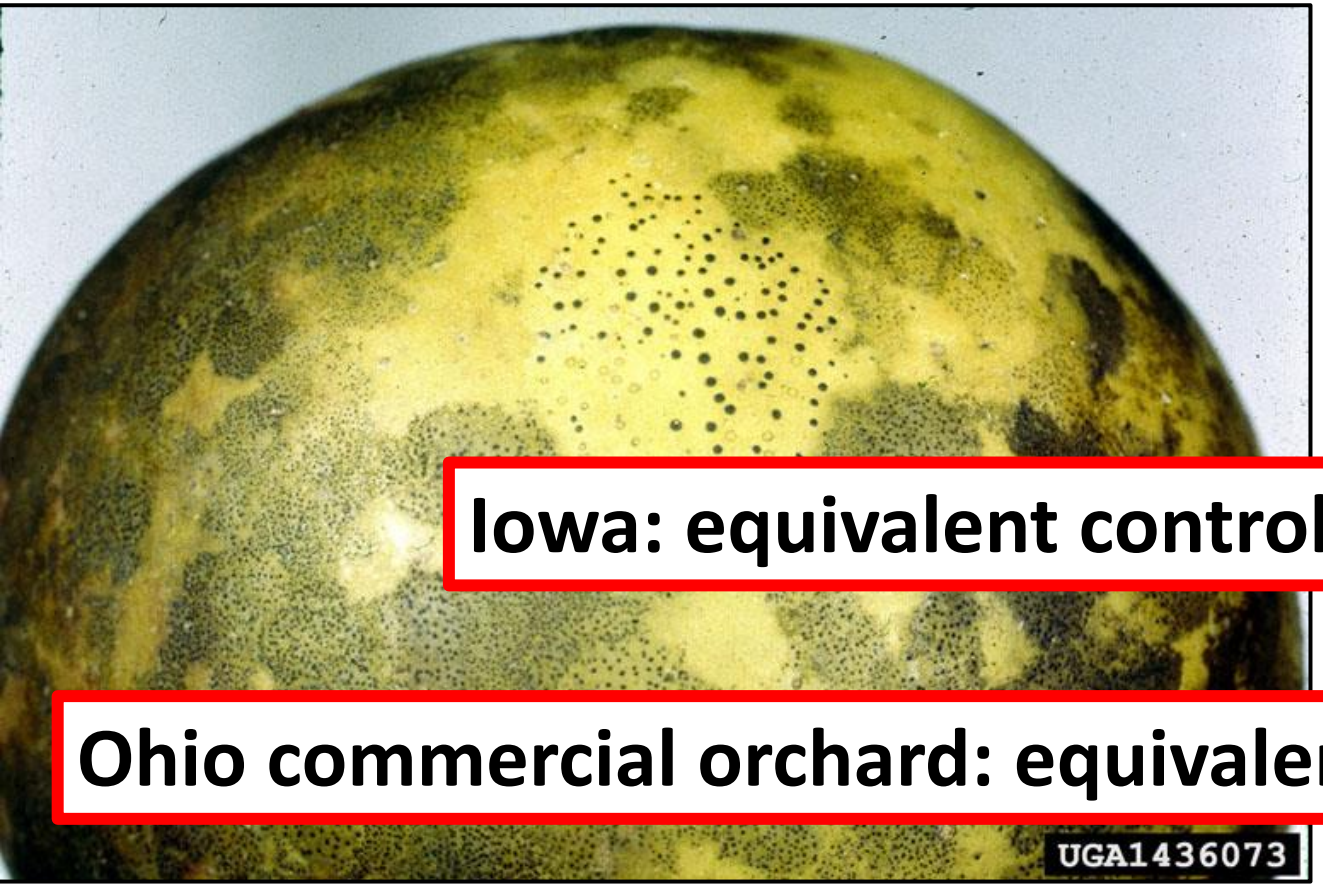


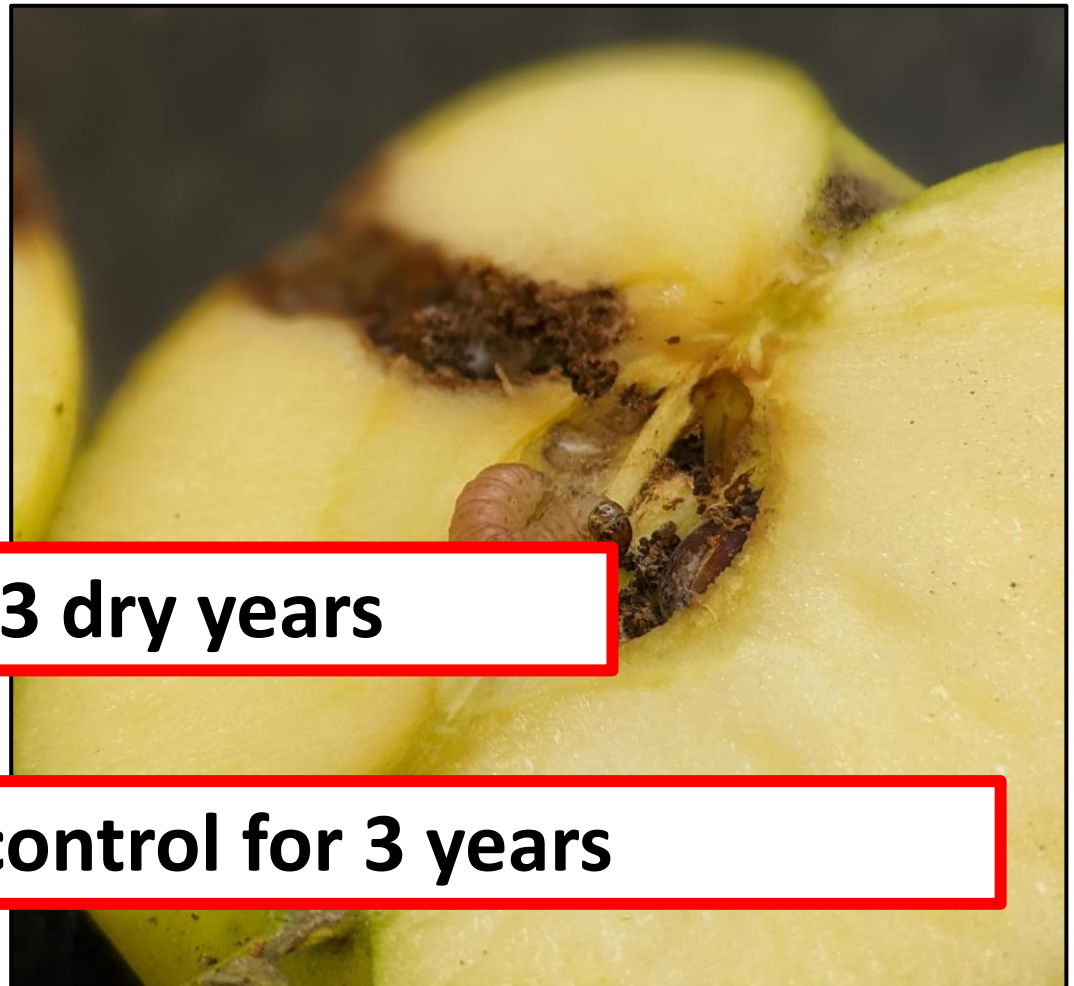
Intelligent
(0.09 fl oz/ft3)
25%



Standard
(100 gal/A)
25%

What about pest and disease control?





Iowa: equivalent control in 3 dry years

Ohio commercial orchard: equivalent control for 3 years

Dr. Mark Gleason leads investigations of intelligent sprayers to apply pesticides in apple orchards for IPM programs

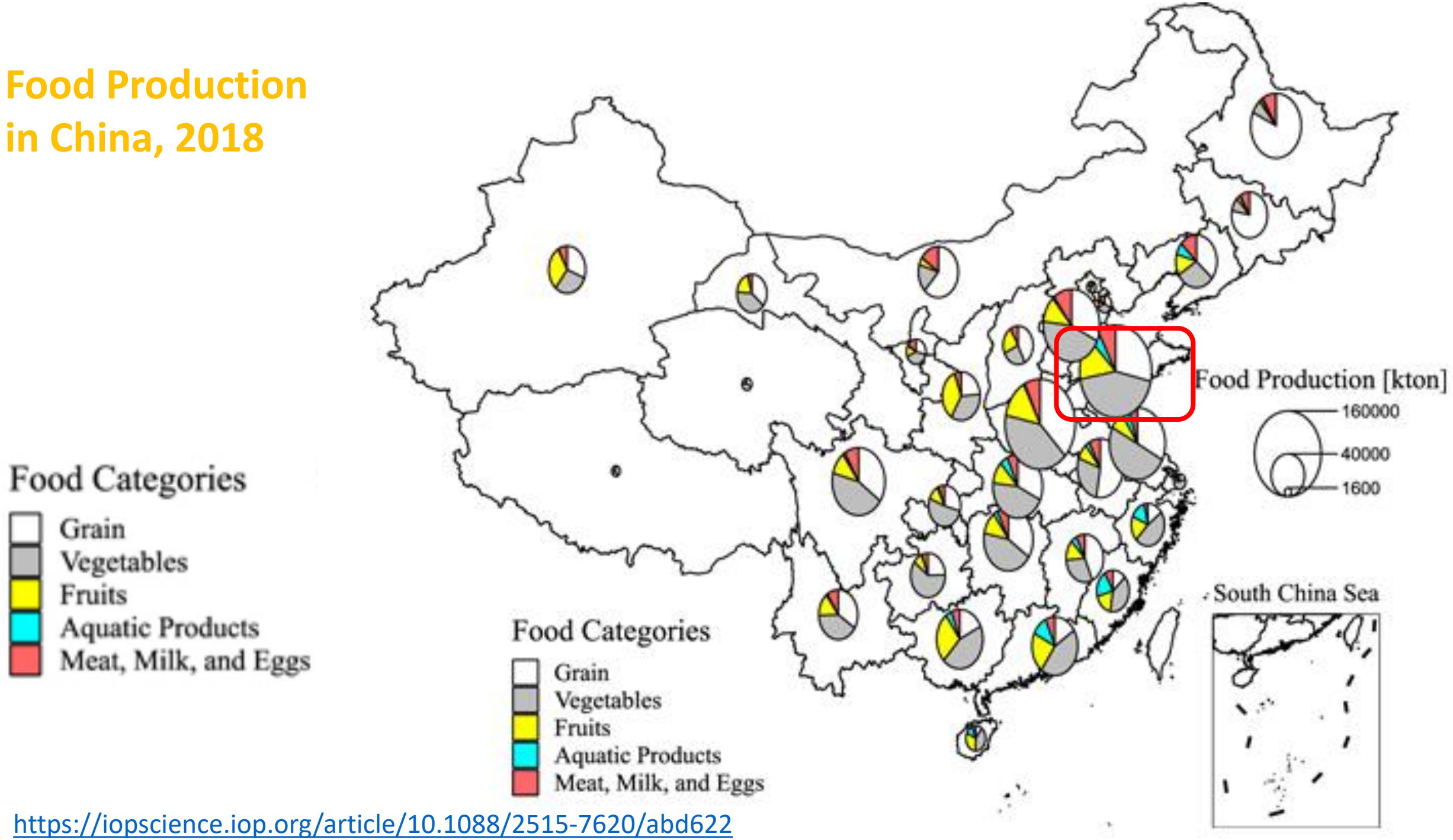
Project's objectives are:

- Assess combining Intelligent Sprayer technology with warning systems for fire blight and summer diseases to achieve season-long pest and disease management of apples.
- Compare economic profitability and cost effectiveness of using the Intelligent Sprayer with disease-warning systems to current practices for control of apple diseases and arthropod pests.
- Share the projects' advances with apple growers in the eastern half of the U.S. through diverse outreach approaches and an IPM Information Portal.

https://www.smartapplespray.plantpath.iastate.edu/

Story #3: Vegetable Production in My Hometown in China

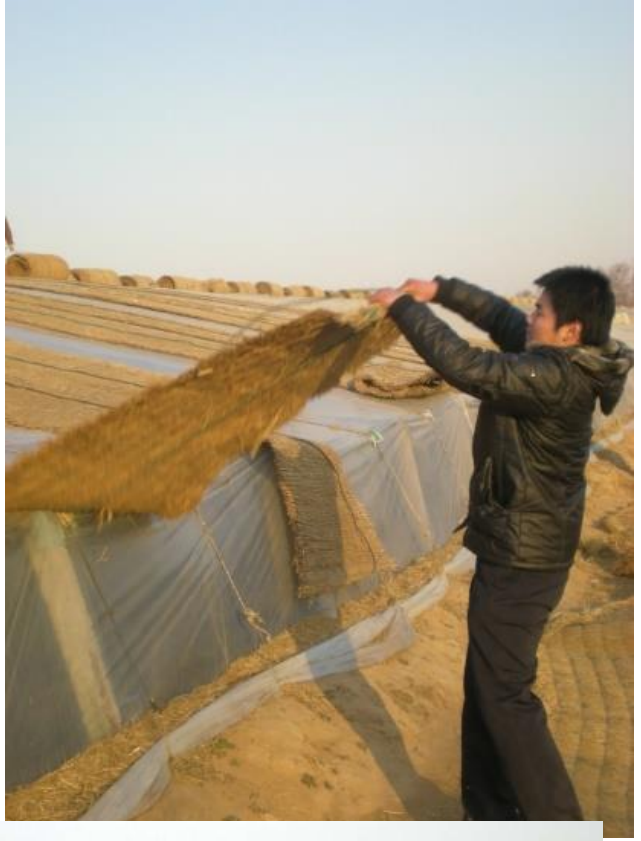
Food Production in China, 2018



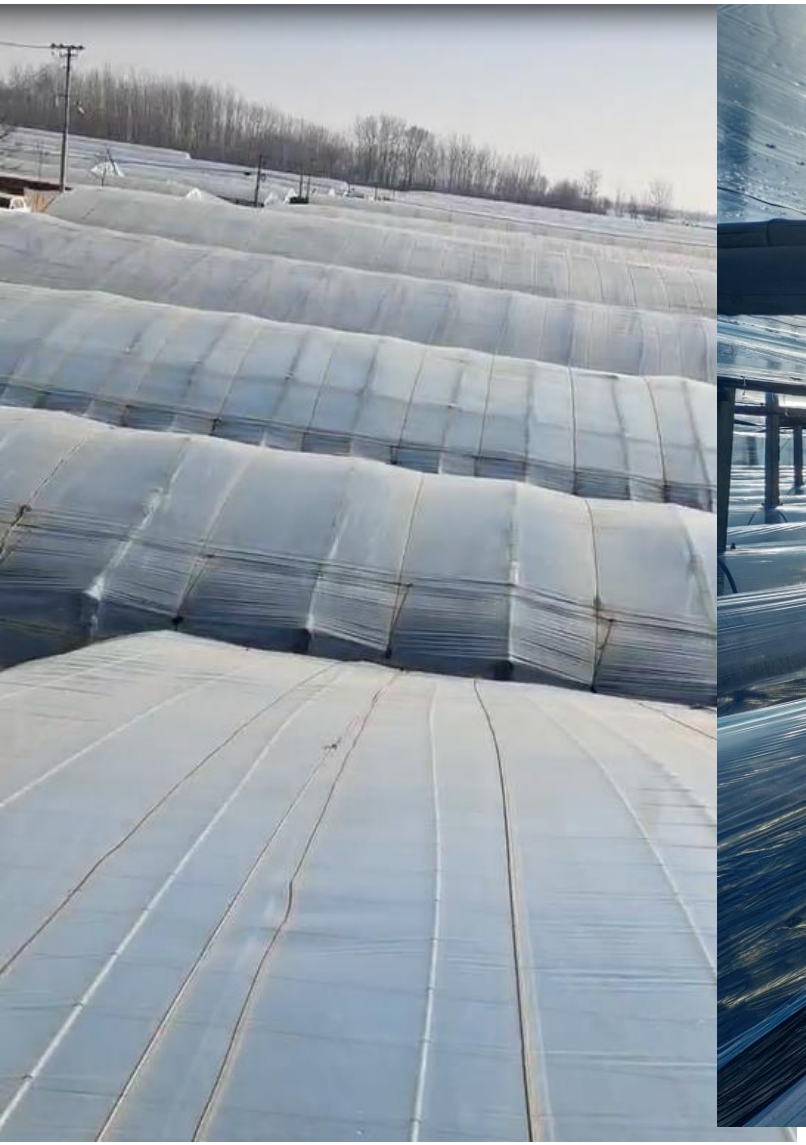
https://iopscience.iop.org/article/10.1088/2515-7620/abd622

Agricultural transformation in my hometown

Greenhouse – plastic film - Shandong Province



Now the high-tunnel production system has been upgraded



Thank you!

Wendong Zhang
wendongz@cornell.edu

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